Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/137
UNITED KINGDOM
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

GRAPHITE CORE STRUCTURES FOR LARGE GAS-COOLED POWER REACTORS

by

P. C. Warner[+]
M. A. Bayer[+]

The core of a gas-cooled graphite moderated reactor consists of columns of graphite pierced by vertical channels for control and for fuel. The structure must be capable of accepting irradiation distortion and differential thermal movements and at the same time be stable against loads due to gas pressure differences, fuel handling, and in some cases seismic forces. For large cores, it is advisable to design the structure so that each column is located independently of its lateral strain and is held vertical by some suitable skeleton. In this way not only is it insensitive to the exact value of irradiation strains but the misalignment of columns is kept to a minimum. The usual solution is to use radial keys on the graphite components so as to form a layer which changes its pitch in a consistent pattern when the boundary is expanded or contracted as a whole. The periphery may be fixed to a steel structure, or to a graphite arch held in place by elastic garters compensated for temperature. Other structural problems include bowing of blocks caused by differential shrinkage and gas bursting forces especially under burst duct fault conditions. The other main problem in core design is to prevent gas by-passing fuel channels. The spaces between bricks have to be vented to the top of the core because of control requirements so the bottom layer has to seal across the base either in the form of a steel plate or by butting reflector blocks solid. Gas leaks out of fuel

[+]United Power Co. Ltd., London.

channels through the permeable graphite and through the joints between blocks, and a system without sleeves should incorporate special sealing features between blocks to prevent excessive leakage after long term distortion.

The Hunterston, Trawsfynydd, and Tokai Mura core designs all embody keyed layers to cater for thermal and irradiation strains, but Trawsfynydd expands as graphite, Tokai Mura as steel, and Hunterston uses a mixed solution. A study of these core designs shows how the problems have manifested themselves in a slightly different way on each one and have resulted in different solutions and development requirements. It is interesting to consider how the same problems manifest themselves on a current large magnox unit for 500 MW n.e.o. and to describe a core design for it based on the experience of the three earlier reactors. This leads to a core with deep keyed layers alternating with plain layers, spiggoted into a steel at the bottom and at the periphery. Similar principles can be adopted on a core for an advanced gas reactor.